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July 2, 1956

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Dear 

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I have completed some experiments on the reaction of water with lithium aluminum hydride. This reaction goes cleanly and is easily controlled in the presence of a small amount of dioxane but the hydrogen which comes off contains too much dioxane vapor for your purpose. The reaction goes quite as well with ethylene diamine, and in this case the amount entrained with the hydrogen gas is negligible.

I have made some engineering calculations on the full-scale process and am confident I can make a kit weighing not more than 225 lbs which will furnish 4,250 cubic feet of hydrogen (gross lift of 300 lbs) at 70 F. This weight is made up as follows:

Lithium aluminum hydride	140 lbs.
Hydride container	20
Ethylene Diamine (anhydrous) and container	35
Cooler	15
Tools	5
Grate	10

The bulk density of the lithium aluminum hydride as received is approximately 28 lbs. per cubic foot, and the material swells on reaction to a soft, fluffy powder of bulk density approximately 14 lbs. per cubic foot, net counting the weight of the added water. In other words, at the end of the reaction the volume of the products is approximately twice that of the starting material. Thus the reaction vessel must have a volume of approximately 10 cubic feet.

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The reaction vessel contemplated is a cylinder of diameter and height each 28 inches. Since this reactor operates at a maximum temperature of approximately 120 C. the joints should be weither brazed or flanged and bolted.

An explosion may occur if liquid water is allowed to accumulate inside the reactor. There is no danger of this happening in the early stages of the reaction if, as planned, the water is dripped down on to the top of the charge. The temperature soon rises to 120 C. (the boiling point of ethylene diamine) and should be maintained there so that liquid water cannot at any time be present. The reaction takes place between steam and the solid lithium aluminum hydride. The excess heat is removed be the vaporization of ethylene diamine, which is condensed by contact with a water-cooled surface (the cooler) and returned to the reactor, with added water. The total heat which has to be removed is 250,000 BTU. If the total reaction requires 4 hours, and if half the heat goes out through the reactor walls and half to the cooler surfaces (total of 8 square feet) the heat flux through the walls of the reactor is 280 BTU per square foot per hour, and through the cooler surfaces is 390 BTU per square foot per hour.

It may be possible to reduce the weight of the kit by using lithium hydride instead of lithium aluminum hydride. The amount of heat which has to be handled per unit lift is approximately the same. I shall try this as soon as I can get some lithium hydride.

Should I proceed now to the construction of a full-scale kit, or a part-scale kit, or should I come to your office for discussion of the project? Please advise.

My bill for work during July is enclosed.

Very truly yours,



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